

## WHAT IS CLAIMED IS:

1. A thermally conductive resin sheet member  
attaching lead frame wherein a lead frame comprises a  
5 thermally conductive resin sheet member and it is  
integrated with the thermally conductive resin sheet  
member on the lead frame, the thermally conductive resin  
sheet member being formed from a thermosetting resin  
mixture which comprises 70 to 90 parts by weight of an  
10 inorganic filler and 5 to 30 parts by weight of a  
thermosetting resin composition comprising a thermosetting  
resin, and the thermosetting resin is in a semi-cured state.

2. The lead frame according to claim 1 wherein the  
thermally conductive resin sheet member has a gel time in  
15 the range between 20 seconds and 120 seconds at a  
temperature of 155 °C.

3. The lead frame according to claim 2 wherein the  
thermally conductive resin sheet member has a viscosity in  
the range between  $10^2$  Pa.s and  $10^5$  Pa.s.

20 4. The lead frame according to claim 2 wherein the  
lead frame includes a through opening, and the through  
opening is filled with the thermally conductive resin sheet  
member so that the thermally conductive resin sheet  
member and the lead frame are integrated so as to form a  
25 flushed surface.

5. The lead frame according to claim 2 wherein the thermosetting resin composition contains as a main component at least one selected from the group consisting of a bisphenol A epoxy resin, a bisphenol F epoxy resin and a liquid phenol resin.

6. The lead frame according to claim 2 wherein the inorganic filler is at least one selected from the group consisting of  $\text{Al}_2\text{O}_3$ ,  $\text{MgO}$ ,  $\text{BN}$  and  $\text{AlN}$ ,

7. The lead frame according to claim 2 wherein the thermally conductive resin sheet member is integrated with a portion of the lead frame, and the lead frame is such that through a common terminal which is connected to an outer frame portion of the lead frame, other terminal of the lead frame is electrically connected to the outer frame portion.

8. The lead frame according to claim 2 wherein the thermally conductive resin sheet member comprises at least one terminal on its side on which the lead frame is located, and the terminal is electrically independent of the lead frame which is integrated with the thermally conductive resin sheet member.

9. A process of producing a thermally conductive resin sheet member attaching lead frame which comprises a lead frame which is located on and which is integrated with a thermally conductive sheet member formed from a thermally conductive resin mixture comprising an inorganic

filler and a thermosetting resin composition which member comprises a thermosetting resin in a semi-cured state, the process comprising the steps of:

5 (a) obtaining the thermally conductive resin sheet member from the thermally conductive resin mixture comprising the inorganic filler and the thermally conductive resin composition which comprises the thermosetting resin,

10 (b) thermally treating the thermally conductive resin sheet member so that it has a predetermined gel time, and

15 (c) placing the lead frame on the thermally conductive resin sheet member and pressing them toward each other under a temperature at which curing of the thermally conductive resin does not proceed so as to integrate the lead frame and the sheet member.

20 10. The process of producing the lead frame according to claim 9 wherein the predetermined gel time is in the range between 20 seconds and 120 seconds at a temperature of 155°C.

25 11. The process of producing the lead frame according to claim 9 wherein the lead frame includes a through opening, and the through opening is filled with the thermally conductive resin sheet member in the step (c) so that the thermally conductive resin sheet member and the lead frame are integrated so as to form a flushed surface.

12. The process of producing the lead frame

according to claim 9 which comprises the step of forming the thermally conductive resin sheet member into a predetermined shape after the step (b) and before the step (c).

5           13. The process of producing the lead frame  
according to claim 12 wherein the step of forming the  
thermally conductive resin sheet member into the  
predetermined shape comprises sandwiching the thermally  
conductive resin sheet member between a pair of plates  
10           and allowing the plates to approach to each other so as to  
press the thermally conductive resin sheet member such  
that a predetermined spacing between the plates is  
achieved whereby the thermally conductive resin sheet  
member having a predetermined thickness is obtained, and  
15           then forming the thermally conductive resin sheet member  
into the predetermined shape.

          14. The process of producing the lead frame  
according to claim 9 which comprises removing a portion of  
the lead frame which has been integrated with the thermally  
20           conductive resin sheet member after the step (c).

          15. The process of producing the lead frame  
according to claim 9 wherein in the step (c), the thermally  
conductive resin sheet member and the lead frame are  
sandwiched between two plates, the plates are allowed to  
25           approach to each other so that a spacing between them

becomes as predetermined, whereby the thermally  
conductive resin sheet member and the lead frame are  
pressed toward each other so that the thermally conductive  
resin sheet member which is integrated with lead frame and  
5 which has a predetermined thickness is obtained, and

the process further comprises the step (d) in which the  
thermally conductive resin sheet member which has been  
integrated with the lead frame is formed into a  
predetermined shape.

10 16. The process of producing the lead frame  
according to claim 15 wherein the predetermined gel time is  
in the range between 20 seconds and 120 seconds at a  
temperature of 155 °C.

15 17. The process of producing the lead frame  
according to claim 15 wherein the lead frame includes a  
through opening, and the through opening is filled with the  
thermally conductive resin sheet member in the step (c) so  
that the thermally conductive resin sheet member and the  
lead frame are integrated so as to form a flushed surface.

20 18. The process of producing the lead frame  
according to claim 15 which comprises removing a portion  
of the lead frame which has been integrated with the  
thermally conductive resin sheet member after the step (d).

25 19. A process of producing a thermally conductive  
substrate comprising a thermally conductive resin sheet

member, a lead frame and a heat dissipation metal plate which comprises the steps of:

5 (1) placing the heat dissipation metal plate on the thermally conductive resin sheet member attaching lead frame which is produced by the process according to claim 9 so that the lead frame and the metal heat dissipation metal plate are opposed through the thermally conductive resin sheet member,

10 (2) thermally treating the thermally conductive resin sheet member attaching lead frame and the heat dissipation metal plate without pressing them to each other for a predetermined period at a temperature not lower than a temperature at which cure of the thermosetting resin proceeds, and

15 (3) thereafter, pressing the lead frame and the heat dissipation metal plate to each other while continuing the thermal treatment so that the cure of the thermosetting resin further proceeds while the heat dissipation metal plate is integrated with the thermally conductive resin sheet member attaching lead frame.

20 20. The process of producing the thermally conductive substrate according to claim 19 wherein the gel time of the thermally conductive resin sheet member of the thermally conductive resin sheet member attaching lead frame in the  
25 step (1) is in the range between 20 seconds and 120

seconds at a temperature of 155 °C.

21. The process of producing the thermally conductive substrate according to claim 19 wherein as to the thermally conductive resin sheet member attaching lead frame in the step (1), the lead frame includes a through opening, and the through opening is filled with the thermally conductive resin sheet member in the step (c) so that the thermally conductive resin sheet member and the lead frame are integrated so as to form a flushed surface.

22. The process of producing the thermally conductive substrate according to claim 19 which in the step (1) comprises the step of forming the thermally conductive resin sheet member into a predetermined shape after the step (b) and before the step (c).

23. The process of producing the thermally conductive substrate according to claim 22 wherein the step of forming the thermally conductive resin sheet member into the predetermined shape comprises sandwiching the thermally conductive resin sheet member between a pair of plates and allowing the plates to approach to each other so as to press the thermally conductive resin sheet member such that a predetermined spacing between the plates is achieved whereby the thermally conductive resin sheet member having a predetermined thickness is obtained, and then forming the thermally conductive resin sheet member

into the predetermined shape.

24. The process of producing the thermally conductive substrate according to claim 19 which comprises removing a portion of the lead frame which has been integrated with the thermally conductive resin sheet member after the step (c) in the step (1).

25. The process of producing the thermally conductive substrate according claim 19 which comprises further thermally treating the thermally conductive substrate after the step (3) so that the thermosetting resin is sufficiently cured.

26. A process of producing a thermally conductive substrate comprising a thermally conductive resin sheet member, a lead frame and a heat dissipation metal plate which comprises the steps of:

(1) placing the heat dissipation metal plate on the thermally conductive resin sheet member attaching lead frame which is produced by the process according to claim 15 so that the lead frame and the metal heat dissipation metal plate are opposed through the thermally conductive resin sheet member,

(2) thermally treating the thermally conductive resin sheet member attaching lead frame and the metal heat dissipation metal plate without pressing them to each other for a predetermined period at a temperature not lower than



a temperature at which cure of the thermosetting resin proceeds, and

(3) thereafter, pressing the lead frame and the heat dissipation metal plate to each other while continuing heating so that the cure of the thermosetting resin further proceeds while the heat dissipation metal plate is integrated with the thermally conductive resin sheet member attaching lead frame.

27. The process of producing the thermally conductive substrate according to claim 26 wherein the gel time of the thermally conductive resin sheet member of the thermally conductive resin sheet member attaching lead frame in the step (1) is in the range between 20 seconds and 120 seconds at a temperature of 155 °C.

28. The process of producing the thermally conductive substrate according to claim 26 wherein as to the thermally conductive resin sheet member attaching lead frame in the step (1), the lead frame includes a through opening, and the through opening is filled with the thermally conductive resin sheet member in the step (c) so that the thermally conductive resin sheet member and the lead frame are integrated so as to form a flushed surface.

29. The process of producing the thermally conductive substrate according to claim 26 which comprises removing a portion of the lead frame which has been integrated with

the thermally conductive resin sheet member after the step (d) in the step (1).

30. The process of producing the thermally conductive substrate according to claim 26 which comprises further  
5 thermally treating the thermally conductive substrate after the step (3) so that the thermosetting resin is sufficiently cured.

31. A process of producing a thermally conductive substrate comprising a thermally conductive resin sheet member, a lead frame and a heat dissipation metal plate  
10 which process comprises the steps of:

(A) forming a thermally conductive resin sheet member from a material comprising an inorganic filler and a thermally conductive resin composition which comprises at  
15 least a thermosetting resin,

(B) thermally treating the thermally conductive resin sheet member so that it has a predetermined gel time,

(C) placing the heat dissipation metal plate on the thermally conductive resin sheet member and pressing them  
20 to each other at a temperature which does not allow cure of the thermosetting resin to proceed, so that they are integrated together,

(D) placing a lead frame on the thermally conductive resin sheet member which has been integrated with the  
25 heat dissipation metal plate so that the lead frame and the

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heat dissipation metal plate are opposed through the thermally conductive resin sheet member, and

(E) thermally treating the lead frame and the thermally conductive resin sheet member which has been integrated with the heat dissipation metal plate at a temperature which is not lower than a temperature which allows the cure of the thermosetting resin to proceed while pressing the lead frame and the metal heat dissipation plate to each other under at a predetermined pressure and allowing the cure of the thermosetting resin to proceed.

32. The process of producing the thermally conductive substrate according to claim 31 wherein the predetermined gel time is in the range between 20 seconds and 120 seconds at a temperature of 155 °C.

33. The process of producing the thermally conductive substrate according to claim 31 wherein the lead frame includes a through opening, and the through opening is filled with the thermally conductive resin sheet member in the step (E) so that the thermally conductive resin sheet member and the lead frame are integrated so as to form a flushed surface.

34. The process of producing the thermally conductive substrate according to claim 31 which comprises the step of forming the thermally conductive resin sheet member into a predetermined shape after the step (B) and before the step

(C).

35. The process of producing the thermally conductive substrate according to claim 34 wherein the step of forming the thermally conductive resin sheet member into the predetermined shape comprises sandwiching the thermally conductive resin sheet member between a pair of plates and controlling a spacing between the plates to be a predetermined distance so as to press the thermally conductive resin sheet member whereby the thermally conductive resin sheet member having a predetermined thickness is obtained, and then forming the thermally conductive resin sheet member into the predetermined shape.

36. The process of producing the thermally conductive substrate according claim 31 which comprises further thermally treating the thermally conductive substrate after the step (E) so that the thermosetting resin is sufficiently cured.